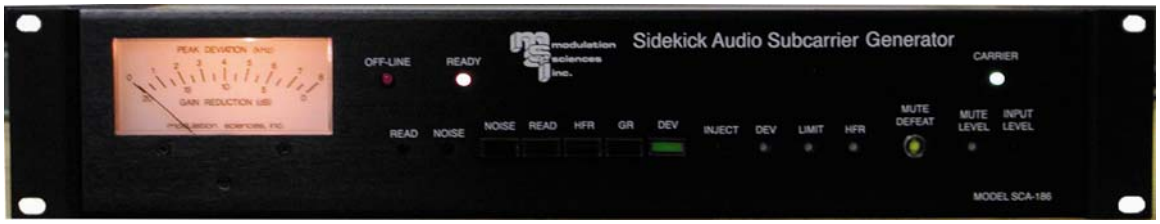
MODULATION SCIENCES INC.

Operation Manual



SCA-186 Sidekick
Audio Subcarrier Generator

OPERATION MANUAL – REV. 2

SCA-186 Audio Subcarrier Generator

Revision 2 – March 23, 2006

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Chapter 1: Special Features

1.1 Introduction

The Modulation Sciences, Inc. SCA-186 SIDEKICK combines the four elements needed for successful SCA operation: subcarrier generator, modulation monitor, audio processor and transmitter tuning aid. Modulation Sciences has engineered these four devices into one package, designed to work together. This system approach provides a level of performance previously unobtainable. A dramatic reduction in crosstalk, a significant improvement in signal quality and simplified operation are among the benefits to be derived.

SIDEKICK is cost effective because there is no need for redundant power supplies, packaging, or input/output interfacing for each element. Each subsystem of SIDEKICK is unique and has been specially engineered for its task.

1.2 Subcarrier Generator

SIDEKICK has the first crystal-controlled SCA generator in the industry. Everyone else uses a simple free-running oscillator. Free-runs are easy to design and FM modulate, but their frequency stability usually suffers. Because it is crystal controlled, SIDEKICK has a frequency stability of ± 0.01% over 0 to 50 degrees C.

The SCA carrier is derived from a frequency synthesizer. Any frequency in the current or newly authorized SCA region can be selected by user programmable straps. New crystals will never be needed.

1.3 Modulation Monitor

A built-in modulation meter eliminates the need to purchase an additional modulation monitor for the subchannel.
The modulation meter provided is simple to read and very accurate. The peak/hold indicating circuit causes the meter to raise to the maximum deviation and remain there without much bouncing around. The meter can also be easily calibrated in the field with only a frequency counter and a DC voltage source.

1.4 Integrated Audio Processor

Audio processing has always been a weak link in SCA transmission systems. Typically the audio processing has been a hand-me-down from the main channel. Trying to use a 75 microsecond limiter in a 150 microsecond system results in hardly any high-frequency peak control. SCA generators need audio low-pass filters, much like the infamous 15 kHz filters in stereo generators. The SCA audio filters, which typically cut off around 5 kHz, also ring and overshoot just like their brothers in stereo generators. As in main channel operation, SIDEKICK is designed for 150 microsecond preemphasis, with 75 and zero as user-selectable options. The lowpass audio filter, engineered as an integral part of the system, is overshoot corrected for maximum modulation and minimum crosstalk. An internal port is provided after the audio processing to permit the addition of any noise reduction system desired. This same port can also be used to introduce computer data.

1.5 Transmitter Tuning Aid

This function may be new to some broadcasters. In many transmitters proper tuning of the driver and power amplifier stages plays a major role in minimizing crosstalk between the SCA and main channel and vice versa.

Designed into SIDEKICK is a random noise generator and an incidental AM noise meter. The entire baseband is noise-loaded and incidental AM is measured from an RF sample. The RF tuning can then be "tweaked" for minimum AM. A dramatic reduction in crosstalk often results from this procedure.

All of the devices needed to do minimum AM tuning are built into SIDEKICK. No additional equipment is needed.

Chapter 2

2.1 Specifications

SIZE Inches (mm) H x W x D

FRONT PANEL: 3.5(88.9) x 19(482.6)
CHASSIS: 3.5(88.9) x 16.75(425.5) x 9.25(235)

Power

95 to 130 VAC, 50/60 Hz, 12 W maximum
190 to 260 VAC option available

Temperature Range

0 to 50 degrees C

RF Protection

All inputs and outputs RF suppressed, power supply RF suppressed and shielded from main circuitry.

Controls

See block diagram and accompanying explanation.

Input/Output Connections

AUDIO IN

No. 6 screw terminals
-30 to +10 dBm
600 Ohm resistive ± 2%

REMOTE CONTROL

No. 6 screw terminals
6 to 24 VAC, 10 to 24 VDC

COMPOSITE IN
BNC connector
Unity gain to composite output
10k Ohm unbalanced

COMPOSITE OUT
BNC connector
Stereo level 0.4 to 4 V P-P
SCA level 0.04 to 0.4 V P-P
Noise test level 0.4 to 4 V P-P
50 Ohm output impedance
600 Ohm minimum load impedance

SCA OUT
BNC connector
.35 to 3.5 V P-P
50 Ohm output impedance
600 Ohm minimum load impedance

TELEMETRY IN
BNC connector
3.5 V P-P = ±500 Hz deviation
10 k Ohm

RF IN
BNC connector
0.1 to 2 W
50 Ohm

Frequency Response[1]

-3 dB @ 50 Hz and 5 kHz
± 1 dB 70 Hz to 4 kHz

Noise[2]

65 dB below 5 kHz deviation

[1] Measured with signal below compression threshold.

[2] Measured with 150 uS pre-emphasis (generator) and de-emphasis (receiver).

Frequency Accuracy

± 0.01 % at 25 Degrees C.

Frequency Drift

± 0.005 % from 0 to 50 degrees C.

Spurious Components

2ND HARMONIC: better than 40 dB below sub-carrier
3RD HARMONIC: better than 45 dB below sub-carrier
ALL OTHER COMPONENTS: 50 Hz TO 100 kHz: better than 60 dB below subcarrier

Carrier Suppression when Muted

Better than 50 dB

Muted Level

Adjustable from 10 to 30 dB below peak deviation set by "DEV" control. See block diagram, "Broadband Limiter".

Muted Delay

Selectable from 300 mS to 6 seconds.

Meter Circuit

Peak deviation: ± 5 % accuracy
Synchronous AM: -20 to -60 dB sensitivity

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Chapter 3: Installation

3.1 Installation Location

The SIDEKICK should be installed in a location where the ambient temperature will remain within 0 to 50 degrees C and where it will not be exposed to extremely high magnetic fields. It may be installed in an equipment rack immediately adjacent to most pieces of processing or test equipment; however, a separation of at least 6 to 12 inches from any high-power transformers should be maintained. The only other restriction on location is that cable lengths should not exceed the limits given in the following section.

3.2 Composite and SCA Connections

The COMPOSITE and SCA outputs are driven by high slew rate amplifiers having a 50 Ohm output impedance and able to drive loads as low as 600 Ohms. Up to 30 feet of cable may be used between SIDEKICK and the exciter inputs. Since the COMPOSITE output has considerably more drive capability than is available from most stereo generators or STL receivers, the SIDEKICK may be used as a buffer amplifier to extend the length of cable between the stereo generator or STL receiver and the exciter.

Any signal at the COMPOSITE input appears at the same level at the COMPOSITE output. In addition, the subcarrier signal will normally appear at this output unless an internal strap has been changed. Only the subcarrier signal appears at the SCA output. The subcarrier level at the COMPOSITE output is approximately 10% of the subcarrier level at the SCA output. A number of connections are possible, depending on the inputs available on the exciter and the desired operation.

Of the two methods of connection detailed below, the first is highly preferred for several reasons. First, the SCA performance of different makes of exciters varies widely, depending on the design of their SCA input circuitry, while their composite input characteristics are well defined. Also, many exciters that require a plug-in SCA module do not even have an SCA input. Second, if the SCA input on the exciter is used, it will then be necessary to repatch cables when performing transmitter tuning, since the Sidekick's unique transmitter tuning aid needs access to the wideband input of the exciter. On the other hand, with the Sidekick connected in series with the composite signal from the stereo generator, the transmitter tuning mode can be entered simply by pushing the appropriate buttons on the front panel

of the Sidekick. Another benefit of the preferred connection method is the ability of the Sidekick to serve as a line extension amplifier for the stereo signal due to its high slew rate and low output impedance.

3.3 Preferred Method Using Wideband Input of Exciter Only:

Connect the stereo signal to the COMPOSITE input of SIDEKICK. Connect from the COMPOSITE output to the wideband input of the exciter. The SCA output will not be used in this case. The noise generator signal will be substituted for the stereo signal when both the NOISE and READ buttons on the front panel of the SIDEKICK are engaged.

3.4 If your Exciter has an SCA Input and The Stereo Signal will not be run through the Sidekick :

Connect the SCA output of SIDEKICK to the auxiliary input on your exciter. The COMPOSITE input and output connections will be unused except when the noise generator in SIDEKICK is being used for transmitter tuning. Since the noise test signal appears only at the COMPOSITE output, a temporary connection will have to be made between the COMPOSITE output and the wideband input of the exciter during the tuning procedure.

3.5 Eliminating Hum Problems

Although the SIDEKICK has sufficient output drive capability to handle long cables, hum due to ground loops may still be a problem in some installations if the exciter has an unbalanced input. If you have a hum problem, try improving the ground connection between SIDEKICK and the exciter. Re-routing the cable away from sources of strong magnetic fields may also help. In extreme cases, the only solution may be to locate SIDEKICK closer to the exciter.

3.6 RF Input Connection

The signal at the RF input is applied to an AM demodulator so that synchronous AM can be measured. The measuring circuit includes an automatic RF level compensator so that correct results will be obtained for any RF level from 0.1 to 2 Watts. RF levels above 2 Watts may damage the internal termination resistor.

The RF signal should preferably be obtained from a sampler on the antenna feedline. For best results, the transmitter should be tuned for minimum synchronous AM when driving the antenna, since many transmitters behave somewhat differently when driving a dummy load. If you are on a master antenna installation or are in any other situation where the reverse power in

your antenna feedline may contain some power from stations on other frequencies, it may be necessary to derive the RF sample with a directional coupler to ensure accurate measurement results.

3.7 Audio Input Connections

Connect the audio signal to the screw terminals on the rear of the SIDEKICK. Shielded twisted pair cable is recommended for the audio connection; however, due to the extremely good common-mode rejection of the audio input circuit, non-shielded twisted pair wiring may work acceptably in many installations. The input impedance is 600 ohms resistive, thus ensuring proper termination of telephone lines without the use of external pads. Input signal levels as low as -30 dBm can be accommodated. In most cases this will allow direct connection to telephone lines without the use of external booster amplifiers. The terminal connections for various input levels can be determined from the following table:

INPUT LEVEL (dBm)	STRAP	AUDIO TERMINALS
+6 TO +10	5,6	1,2
-14 TO +5	NONE	1,2
-30 TO -15	NONE	4,5

If you are unsure of the audio level in your application start with the highest level connection and proceed with the rest of the installation instructions. If sufficient gain reduction cannot be achieved with the INPUT LEVEL control at maximum sensitivity, move the input connection to the next lower level setting and try again.

3.8 Remote Control Connections

The remote control signals should be connected to the appropriate screw terminals on the rear panel. Each control input is fully floating and is optically isolated from the internal control circuitry. Control signals may be either AC from 6 to 24 volts or DC from 10 to 24 volts. If DC is used, the polarity marked on the input terminals must be observed. The signal at any remote control terminal should be maintained within 60 volts of chassis ground.

The SIDEKICK can be modified to operate with 5 volt DC control signals by replacing the 4N37 optoisolators on the control inputs with 4N33's. If this is done, however, some care may have to be used to prevent spurious actuation of the remote control inputs.

3.9 Mode and Muting Controls

When power is applied to the SIDEKICK it will normally be in READY mode unless the internal strapping has been changed (See section 6.3). The remote control terminals on the rear panel may be used to switch the unit between READY and OFF-LINE modes. If the MUTE DEFEAT switch is engaged, the subcarrier will be on whenever the unit is in the READY mode. If the MUTE DEFEAT switch is not engaged, the subcarrier will be turned on and off by the muting circuit at whatever audio level is set by the MUTE LEVEL control. The mute delay can be changed by changing the value of an internal resistor (see section 6.6). It is set at the factory to 0.5 second.

3.10 Audio Processor Controls

The processor controls should initially be set as follows:

DEV	1 o'clock
LIMIT	12 o'clock
HFR	12 o'clock
MUTE LEVEL	9 o'clock

3.10.1 Input Level

The INPUT LEVEL control is used to adjust the amount of gain reduction. Set the meter switch to the GR position. The meter should read full scale with no audio input. Now apply normal program audio and adjust the INPUT LEVEL control for the desired amount of gain reduction. At gain reductions of up to 5 dB the unit behaves mostly as a compressor-limiter with very little automatic level control operation. If your program signal maintains a very consistent level and you desire to do a minimum of dynamic range reduction, the gain reduction reading on the meter should be set to between 3 and 5 dB. At gain reductions of greater than 5 dB the automatic level control circuit begins to operate, maintaining a consistent amount of

dynamic range reduction at any gain reduction up to 20 dB. For most program material best results will be obtained for gain reduction readings of 5 to 10 dB.

3.10.2 HFR Limit

Now set the meter switch to the HFR position. If no high frequency reduction is taking place the meter should read full scale (0 dB gain reduction). Most program material will cause gain reductions of 5 to 15 dB when 150 microsecond pre-emphasis is used. The amount of high frequency reduction is adjusted by the HFR control and is also affected by the setting of the LIMIT control. These two controls should be adjusted while listening to the signal until the desired sound is obtained. The following paragraphs outline the effects and interactions of these controls.

The high frequency limiter is effectively a program-controlled equalizer. When it detects excessive amounts of high frequency signal, it introduces a high frequency roll-off to keep peaks below its threshold. The broadband limiter sets an instantaneous deviation limit, removing any peaks which exceed its threshold. The threshold control circuit continuously monitors the amount of broadband limiting and will reduce the threshold levels of both the high frequency limiter and the compressor if an excessive amount of broadband limiting takes place. The LIMIT control sets the threshold of both the high frequency limiter and the compressor relative to the broadband limiter.

Turning the HFR control CW will cause increasing amounts of high frequency rolloff, thus causing the signal to sound "duller". However, since high frequency peaks will be reduced in level, this will allow increased RMS modulation, thus reducing apparent crosstalk into the SCA channel . Turning the LIMIT control CW causes less compression and high frequency limiting to occur. Thus, increasing numbers of peaks will be removed by the broadband limiter. When done in moderation, this will increase the RMS modulation of the signal and will usually make it sound somewhat brighter. When done excessively, this will cause transients to sound "splashy" and distorted. In general, the maximum CW setting of both controls cannot be used at the same time. A compromise setting must be found which yields maximum RMS modulation without making the signal sound dull or distorted.

3.10.3 Deviation

After appropriate settings for the processor controls have been found, set the meter switch to the DEV position and adjust the DEV control for the desired peak deviation.

3.11 Transmitter Tuning for Minimum Crosstalk

Connect an RF input signal to the SIDEKICK as described under "RF INPUT CONNECTION". Simultaneously engage the NOISE and READ switches. This removes the composite input signal and connects the internal noise generator to the COMPOSITE output. If your stereo signal does not run through the SIDEKICK, you will need to make a temporary connection from the COMPOSITE output to the wideband input of your exciter. Adjust the NOISE control for 100% total modulation using your modulation monitor. Adjust the READ control for a mid-scale reading on the meter. Now adjust the transmitter tuning to minimize the meter reading, if necessary readjusting the READ control to maintain a convenient reading on the meter. In general, transmitters which produce minimum synchronous AM have less crosstalk between main and SCA channels, and vice versa. Some compromise may be necessary, however, to maintain an acceptable efficiency for the transmitter. Minimum crosstalk tuning, because it alters the efficiency factor of the transmitter, necessitates that output power be determined by the direct method.

Chapter 4: Maintenance

4.1 Factory Service

Each SCA-186 is subjected to an extensive multi-stage test procedure, including a minimum 72-hour burn-in, before leaving the factory. Should any problems arise which cannot be corrected by simply replacing a defective integrated circuit (all of which are socketed for easy replacement), the unit should be returned to the factory for service after first determining that the problem is not in some other piece of equipment. If you have any doubt as to the cause of any problem that may be associated with the unit, the MSI engineering staff will be glad to respond to phone inquiries.

When returning your unit for service, in order to insure proper handling be sure to enclose a letter describing the nature of the malfunction, and your company name and shipping address. (See page 5.5.)

In general, any failure due to defects in materials or workmanship during your first year of ownership should be covered by warranty. For full details, see "Modulation Sciences, Inc. Standard Warranty", Chapter 5.

4.2 Field Repair

As was mentioned above, MSI recommends that defective units be returned for factory service. If you must attempt field service, the following points should be kept in mind:

1. Some components are specially tested and/or matched to extremely tight tolerances. (See the parts list, Chapter 6 for details.) Replacing any of these components by an untested equivalent may result in severely degraded performance. It is especially important that matched components be replaced in groups rather than singly. MSI will be happy to supply sets of matched components for a nominal cost, should you require them.

2. When replacing components, care should be taken not to overheat traces in de-soldering. For ease of removal, we suggest cutting component leads flush with the top of the board before attempting de-soldering (from the bottom).

3. Replacing certain components may make it necessary to retrim one or more of the various trim pots or the variable capacitor CV1.

4. The above information, and any other material relating to servicing, is provided as a courtesy to those who feel that they must do their own repairs. MSI assumes no liability for damage or other problems arising from attempts to service units in the field. Any attempt at user servicing will void the warranty on that unit, although MSI will of course continue to provide non-warranty service at prevailing rates.

Chapter 6 provides further information on the operation of the SCA-86. We will be glad to respond to phone inquiries for additional information relating to particular problems that may arise.

Chapter 5: Modulation Sciences, Inc. Standard Warranty

5.1 For a Summary of this Text and Information on Obtaining Warranty Service, please see pages following this Warranty.

SELLER warrants the products sold shall be free from defects in materials and workmanship under normal use and service for a period of one (1) year from the date of delivery when properly installed. SELLER's sole obligation under this warranty shall be limited to repair or replacement at SELLER's option of any such part or parts of the products which may prove defective under normal use and service within said one (1) year and which the SELLER's examination shall disclose to its satisfaction to have been defective. If BUYER wishes to have warranty services performed at the facilities of SELLER, BUYER shall obtain, in advance, permission to return product(s), and shall ship said product(s) properly packed and insured to the address specified. Service performed at the facilities of SELLER under this warranty shall include parts plus labor. Items returned under this warranty must be transportation prepaid unless otherwise agreed by SELLER. It is expressly agreed that SELLER's obligation to repair or replace defective parts is the sole and exclusive remedy of BUYER for breach of this warranty. UNDER NO CIRCUMSTANCES SHALL SELLER BE LIABLE FOR ANY OTHER DAMAGES, EITHER DIRECT OR CONSEQUENTIAL.

SELLER may, from time to time, make certain representations concerning the compliance of its products with the Rules and Regulations of particular governmental agencies. No such representation can be a basis of the bargain unless it is in writing by an authorized representative of SELLER. Should this representation be found to be untrue, BUYER's sole remedy is the right of recission at BUYER's option. Under no circumstances shall SELLER be liable for any other damages, either direct or consequential.

THE WARRANTY TO REPAIR OR REPLACE DEFECTIVE PARTS AND THE REPRESENTATION OF COMPLIANCE WITH GOVERNMENTAL RULES AND REGULATIONS, WHEN GIVEN IN WRITING, ARE EXPRESSLY IN LIEU OF AND HEREBY IN DISCLAIMER OF ALL OTHER EXPRESS WARRANTIES, AND ARE IN LIEU OF AND IN DISCLAIMER AND EXCLUSION OF ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AS WELL AS ALL OTHER IMPLIED WARRANTIES, IN LAW OR EQUITY, AND OF ALL OBLIGATIONS OR LIABILITY ON SELLER'S PART. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION HEREOF.

SELLER neither assumes nor authorizes any person to assume for it any liability or obligation in connection with the sale of SELLER'S product except said repair or replacement of the defective part and, when given, compliance with the applicable governmental agency Rules. SELLER'S liability does not include any labor charges for replacement of parts, adjustments, repairs or any other work done outside SELLER'S factory and SELLER'S LIABILITY DOES NOT INCLUDE ANY CONSEQUENTIAL OR RESULTING DAMAGE TO PERSON, PROPERTY, EQUIPMENT, GOODS, MERCHANDISE, PROFITS, GOODWILL OR REPUTATION ARISING OUT OF ANY DEFECT IN OR FAILURE OF SELLER'S PRODUCTS. SELLER'S obligation to repair or replace shall not apply to any product(s) which shall have been repaired or altered outside SELLER'S factory in any way, or which shall have been subject to negligence, misuse, unauthorized alteration or abuse.

SELLER'S warranty runs only to the FIRST END USER and does not extend, expressly or by implication, to any other person. No claim under this warranty will be allowed for materials damaged in transit. Expenses incurred in connection with claims for which SELLER is not liable here under will be charged to BUYER. SELLER shall not be responsible for any field repairs performed by BUYER unless such work is authorized in writing by SELLER.

5.2 Summary of:
MODULATION SCIENCES, INC. STANDARD WARRANTY
Effective April 1, 1982

NOTE:
This is not the warranty. It is the summary of MSI's standard warranty and a description of how to obtain warranty service. The current, actual warranty is printed in its entirety on the preceding pages and supersedes warranty information which may be found elsewhere.

1. WHO RECEIVES WARRANTY PROTECTION?
   Modulation Sciences' standard warranty protects the original end-user purchaser of record, but does not apply to subsequent owners.

2. WHAT DOES THE WARRANTY COVER?
   Modulation Sciences agrees to repair or replace at its expense any unit which has a defect in materials or workmanship for a period of one (1) year after the date of sale to the original end-user purchaser. This warranty includes all parts, labor, calibration, and packing.

3. WHAT DOESN'T THE WARRANTY COVER?
   MSI's warranty does not cover:

   A. Freight and insurance charges paid by the purchaser in returning the unit for repair.

   B. Defects which result from modifications or repairs to the unit not made by or authorized in writing by Modulation Sciences.

   C. Compensation for incidental or consequential damages resulting from any defect.

   D. Trivial or cosmetic defects which do not affect the unit's ability to function normally.

4. HOW IS THE WARRANTY PERIOD COMPUTED?
   The warranty period begins on the date of delivery to the original end-user purchaser and is in effect for the next 365 days. The starting date is deemed to be the date on the

invoice from Modulation Sciences, its agent, dealer or distributor to the first end-user purchaser. Do not lose your invoice; it is your way to establish your warranty is still in force.

5. WHAT IF THE UNIT CANNOT BE REPAIRED OR IS TOO EXPENSIVE TO REPAIR?
If Modulation Sciences decides not to repair or replace a given unit, Modulation Sciences agrees to refund to the first end-user purchaser its full purchase price. Payment of that amount will end MSI's responsibilities and Modulation Sciences may keep the unit.

6. HOW IS WARRANTY SERVICE OBTAINED?
To claim your rights under this warranty:

1. Contact the dealer or distributor from whom this product was purchased. Describe the problem and ask if there is an easy solution.

2. If your dealer cannot help, contact Modulation Science's service department at the number given on page 1 of this manual and explain the problem. If the unit requires factory service, you will be given a return authorization number.

3. When you have your return authorization number, you may return the unit. Pack it carefully for shipment, preferably using the original shipping carton and packing materials. ASSUME THAT THE BOX WILL BE DROPPED SEVERAL TIMES DURING SHIPMENT. USE UPS OR SOME OTHER PRIVATE CARRIER YOU KNOW TO BE RELIABLE. DO NOT USE THE POSTAL SERVICE. The risk of loss is yours; Modulation Sciences will not be responsible for damage or loss until the package is received by Modulation Sciences. INSURE THE UNIT FOR ITS FULL REPLACEMENT VALUE. SHIP THE UNIT PREPAID TO THE ADDRESS SPECIFIED WHEN YOU RECEIVE YOUR RETURN AUTHORIZATION AND BE SURE TO ENCLOSE A NOTE GIVING THE FOLLOWING INFORMATION:

a) Your company name and shipping address (not a P.O. Box)

b) Your return authorization number

c) A copy of your original invoice establishing the starting date of your warranty

d) As full a description as possible of the problem(s)

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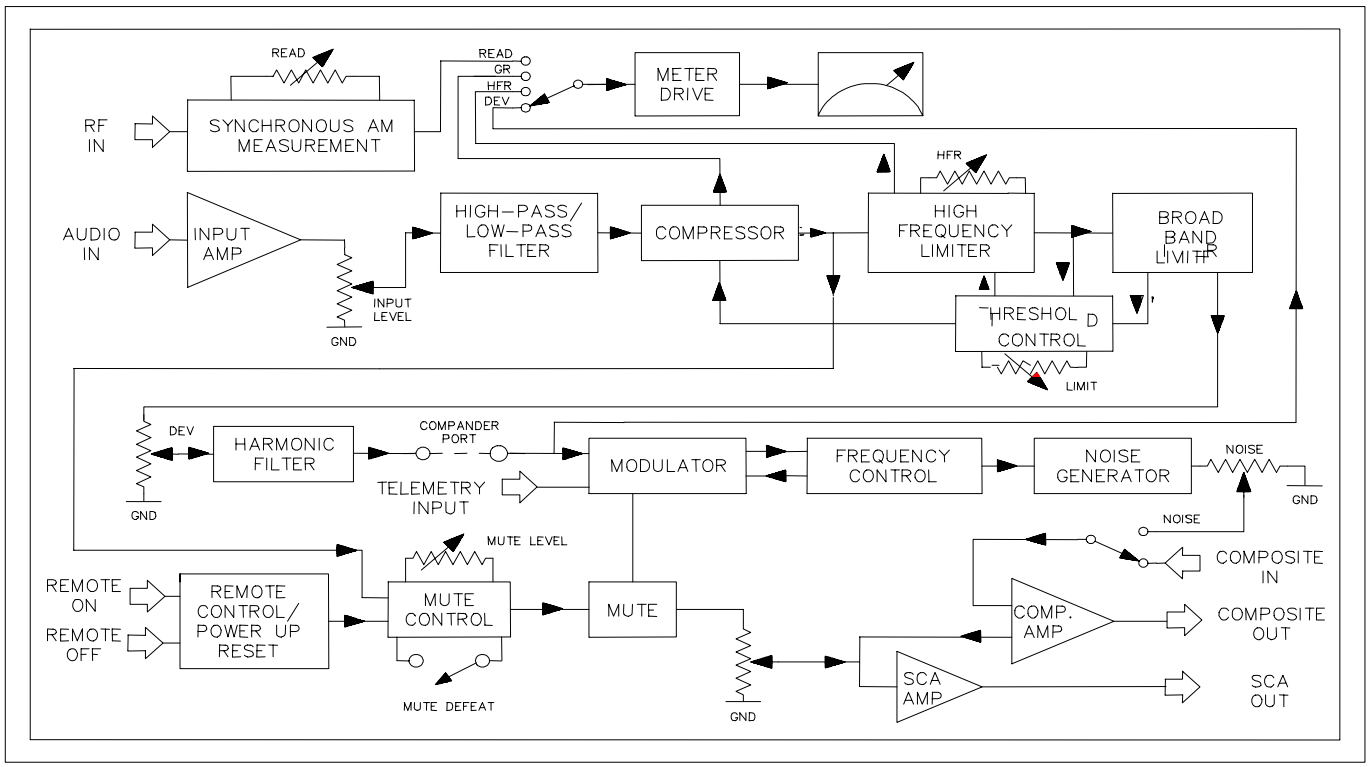
Chapter 6: Field Service

6.1 Block Diagram and Explanation



6.1.1 Input Amp

I.C.: U33

Function: 600 ohm input accepts balanced or unbalanced audio input signals from -30 to +10 dBm.

Controls: "INPUT LEVEL" potentiometer provides gain control at output of this stage.

Options: Input signal level range is selected by connecting appropriate terminals on input terminal strip.

6.1.2 High-Pass, Low-Pass Filters

I.C.: U1

Function: Limits bandwidth to the 50 Hz to 5 kHz range suitable for SCA program material.

6.1.3 Compressor

I.C.'s: U2,3,4,20B

Function: Multiple time constant circuit combines automatic level control and compression.

Controls: Amount of gain reduction is adjusted by interaction between "INPUT LEVEL" and "LIMIT" potentiometers. See "THRESHOLD CONTROL".

6.1.4 High Frequency Limiter

I.C.'s: U5,6,7,13,20A

Function: Provides both pre-emphasis and high frequency gain reduction.

Controls: "HFR" potentiometer adjusts threshold of high frequency limiting relative to the broadband compressor threshold.

Options: Strapping selects either 0, 75, or 150 uS pre-emphasis.

6.1.5 Broadband Limiter

Parts: D40,41,42,43

Function: Sets an absolute limit on program level to prevent overmodulation.

Controls: "DEV" potentiometer sets signal level to modulator. See "THRESHOLD CONTROL".

6.1.6 Threshold Control

I.C.'s: U8,9A,11

Function: Provides feedback control to compressor and high frequency limiter to control balance between limiting and compression.

Controls: "LIMIT" potentiometer sets the desired balance between limiting and compression. By adjusting this potentiometer and the input level control, any desired combination of limiting and compression can be achieved.

6.1.7 Harmonic Filter

I.C.'s: U9B,10

Function: Low-pass filter removes harmonics outside the SCA region.

6.1.8 Compander Port

Parts: P15,16,17

Function: Provides connection point for additional processing or signal injection.

Options: By wire-wrap strapping, the harmonic filter's output connects to the modulator either directly or through an external circuit.

6.1.9 Modulator

I.C.'s: U12A,21

Function: Generates the subcarrier, frequency-modulated by audio program and/or telemetry signals.

Controls/Options: See "FREQUENCY CONTROL".

6.1.10 Frequency Control

I.C.'s: U12B,24,25,26,27

Function: A crystal-controlled digital frequency-locked loop provides precise control of the subcarrier frequency. This circuit also supplies a clock signal to the noise generator.

Options: Any desired subcarrier frequency can be selected by wire-wrap strapping.

6.1.11 Noise Generator

I.C.'s: U28,29,30

Function: Creates pseudo-random pink noise for use in transmitter tuning.

Controls: "NOISE" potentiometer sets level to composite output amp.

6.1.12 Composite Amp

I.C.: U14

Function: Provides output drive to exciter.

Controls: When both "NOISE" and "READ" switches are engaged, the normal composite input is disconnected and the noise generator output is sent to the exciter for transmitter tuning.

Options: Wire-wrap strapping selects input to include or exclude the subcarrier, according to transmitter requirements. This option has no affect on the transmitter tuning mode.

6.1.13 SCA Amp

I.C.: U15

Function: Provides output containing subcarrier only, for exciters that require stereo composite and SCA as separate inputs.

6.1.14 Remote Control / Power-Up Reset

I.C.'s: U22,23A,23B

Function: Provides direct external control of mute circuit, which turns the subcarrier on and off. This circuit also determines the state of the mute circuit when power is first applied to the unit.

Controls: External control voltages from 5 to 24 volts AC or DC, applied to the input terminal strip, turn mute circuit on or off.

Options: The power-up state of the mute circuit is determined by wire-wrap strapping. Normally this would be factory set so that the subcarrier would be turned on when power is first applied.

6.1.15 Mute Control

I.C.'s: U18,19,23C,23D

Function: This circuit activates the mute circuit (turns off the subcarrier) either in response to the remote control / power-up reset circuit, or when the signal level at the output of the compressor falls below the muting threshold.

Controls: "MUTE LEVEL" potentiometer sets the muting threshold. "MUTE DEFEAT" switch, when engaged, causes the subcarrier to remain on regardless of the program level. The remote on/off function is not affected by this switch.

6.1.16 Mute

I.C.: U34

Function: Provides "soft" on/off switching of the subcarrier.

Controls: "INJECT" potentiometer sets the subcarrier level into the composite amp and/or the SCA amp.

Options: See "REMOTE CONTROL / POWER-UP RESET".

6.1.17 Synchronous AM Measurement

I.C.'s: U16,17

Function: Detects (undesirable) AM modulation of main carrier. Transmitter can be tuned for minimum crosstalk by nulling this reading.

Controls: "READ" potentiometer adjusts the sensitivity of the meter reading. See "NOISE GENERATOR" and "COMPOSITE AMP".

6.1.18 Meter Drive

I.C.'s: U31,32

Function: Drives the meter. Also scales levels and selects ballistics to suit parameter being measured. When peak deviation is measured, the ballistics are peak-reading; for others they are averaging.

Controls: Push buttons select meter functions:

"READ" measures synchronous AM, as detailed above.
"GR" measures broadband gain reduction.
"HFR" measures high frequency gain reduction.
"DEV" measures peak deviation of subcarrier (modulation).

6.2 Strap-Selectable Options

NOTE

All option straps are wire-wrapped. Any changes **MUST** be made using standard 30 gauge wire-wrap applied with a wire-wrap tool.

Both manual and motor 30 gauge wire-wrap tools, as well as pre-stripped wire, are available from Radio Shack, Mouser or Digi-Key. The motorized wrapping tool is preferred for the most reliable connections, but the manual tool, if used carefully, appears to work. Standard wire-wrap must be used. It is silver plated and Kynar insulated.

Any solder appearing on any wire-wrap pins **VOIDS ALL WARRANTIES** and will result in an expensive socket replacement before any repairs can be performed to the generator.

OPTION	STRAP	OPEN	LOCATION
Ready on power-up*	P6-P5	P6-P7	B4
Off-line on power-up	P6-P7	P6-P5	B4
Subcarrier to COMPOSITE OUT*	P17-P19	P18-P19	E5
No subcarrier to COMPOSITE OUT	P18-P19	P17-P19	E5
Pre-emphasis:			
150 microsecond*	none	P3-P4 P1-P2	B8
75 microsecond	P3-P4 P1-P2	none	B4

Soldering to the frequency programming pins voids all warranties. Wire wrapping must be used. See the note at the beginning of this section.

*Factory setting

If no pre-emphasis is desired, remove R40 and R41.

Frequency strapping information and deviation meter recalibration are included here for 67 kHz and 92 khz. The SIDEKICK can be set to virtually any desired frequency. If you desire to operate on a frequency other than 67 kHz or 92 kHz, contact Modulation Sciences and we will provide strapping information for your frequency. Because the subcarrier frequency is digitally synthesized, any desired frequency can be obtained by a simple strapping change without replacing the crystal.

6.3 Frequency Strapping

The PC board must be removed from the box since the majority of the frequency straps are on the bottom of the board.

First, on the top of the board, locate pins P15 and P16 at location D8. For 67 kHz, strap P15 to P16. For 92 kHz, remove the strap from P15 to P16.

The remaining straps are on the bottom of the board:

	67 KHZ STRAPS		**92 KHZ STRAPS**	
LOCATION	FROM	TO	FROM	TO
B3	IC27 PIN 5	P10	IC27 PIN 5	P10
B3			IC27 PIN 6	P9
B3			IC27 PIN 7	P8
B2	IC25 PIN 4	V+	IC25 PIN 4	V+
B2	IC25 PIN 5	GND	IC25 PIN 5	V+
B2	IC25 PIN 6	GND	IC25 PIN 6	V+
B2	IC25 PIN 7	GND	IC25 PIN 7	GND
B2	IC25 PIN 10	GND	IC25 PIN 10	GND
B2	IC25 PIN 11	V+	IC25 PIN 11	GND
B2	IC25 PIN 12	V+	IC25 PIN 12	V+
B2	IC25 PIN 13	GND	IC25 PIN 13	GND

NOTE: GND SHOULD BE OBTAINED FROM IC25 PIN 8.
V+ SHOULD BE OBTAINED FROM IC25 PIN 16.

6.4 Deviation Meter Recalibration

From 67 kHz to 92 kHz:

The calibration of the deviation meter will change when the subcarrier frequency is moved, so recalibration is required. If the meter was correctly calibrated at 67 kHz, the following procedure can be used to reset the calibration for 92 kHz:

1. Connect a sine wave generator to the SIDEKICK's audio input and set the frequency of the generator to 200Hz.

2. Push the DEV switch on the SIDEKICK front panel. Set the DEV and LIMIT pots to maximum CW rotation. Set HFR pot to maximum CCW rotation.

3. Connect an accurate AC voltmeter to the output of U31B - a convenient point to find this is the 68k resistor (color bands blue-gray-orange-gold) adjacent to U31 at location F2. Be sure to connect to the end of the resistor at F2, NOT the end at E2. Adjust the output level of the sine wave generator so that the AC voltmeter reads 0.50 volts at U31B out. The INPUT LEVEL control on the SIDEKICK's front panel may be used to trim this reading to precisely 0.50 volts if the output control on the sine wave generator does not have sufficient resolution.

4. Adjust the meter calibration pot RV10 (location E6) to raise the reading on the AC voltmeter to 0.69 volts. The SIDEKICK deviation meter will now be calibrated to read correctly at 92 kHz.

From 92 kHz to 67 kHz:

The calibration of the deviation meter will change when the subcarrier frequency is moved, so recalibration is required. If the meter was correctly calibrated at 92 kHz, the following procedure can be used to reset the calibration for 67 kHz:

1. Connect a sine wave generator to the SIDEKICK's audio input and set the frequency of the generator to 200 Hz.

2. Push the DEV switch on the SIDEKICK front panel. Set the DEV and LIMIT pots to maximum CW rotation. Set HFR pot to maximum CCW rotation.

3. Connect an accurate AC voltmeter to the output of U31B - a convenient point to find this is the 68k resistor (color bands blue-gray-orange-gold) adjacent to U31 at location F2. Be sure to connect to the end of the resistor at F2, NOT the end at E2.

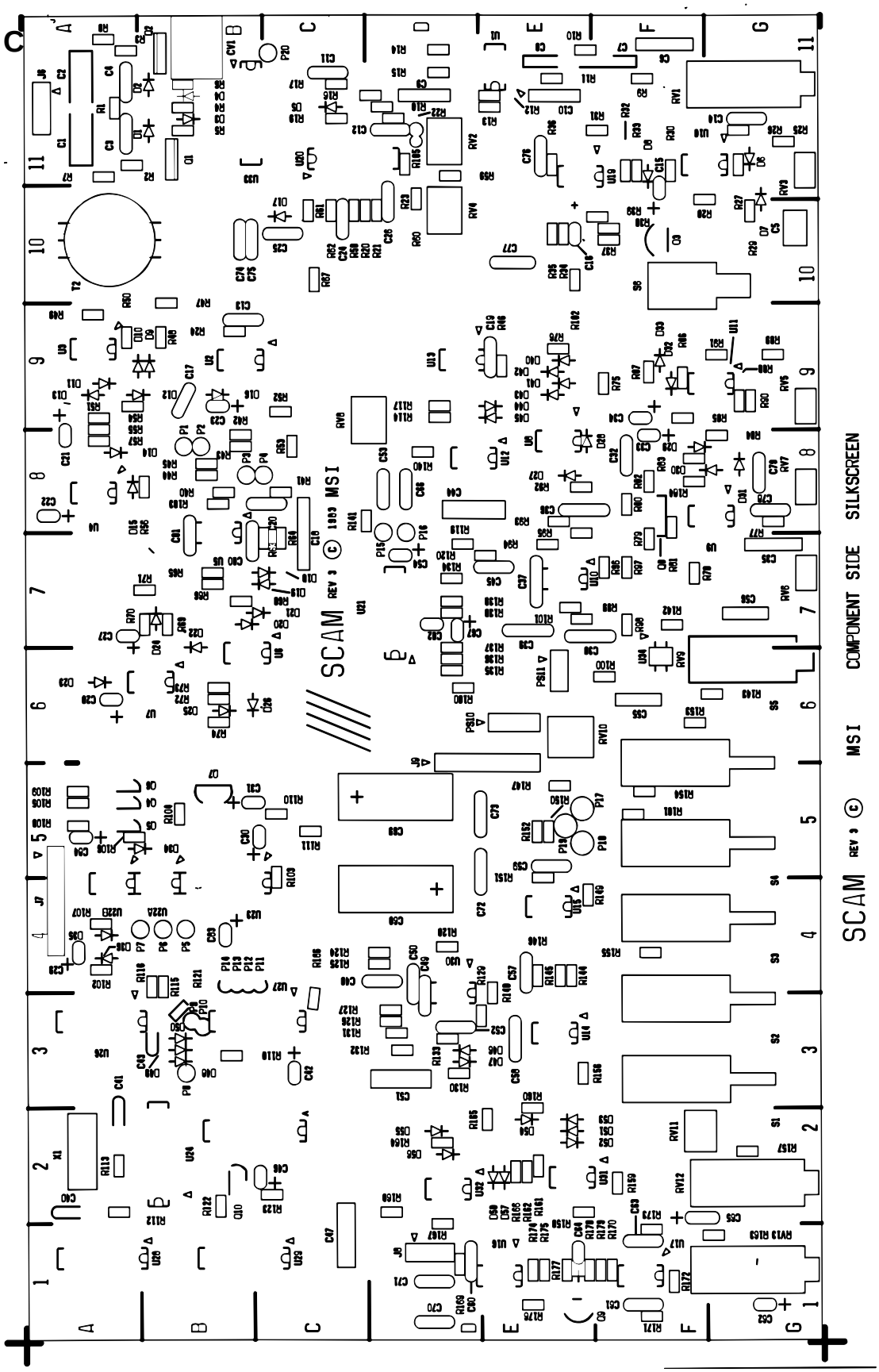
4. Adjust the output level of the sine wave generator so that the AC voltmeter reads 0.69 volts at U31B out. The INPUT LEVEL control on the SIDEKICK's front panel may be used to trim this reading to precisely 0.69 volts if the output control on the sine wave generator does not have sufficient resolution.

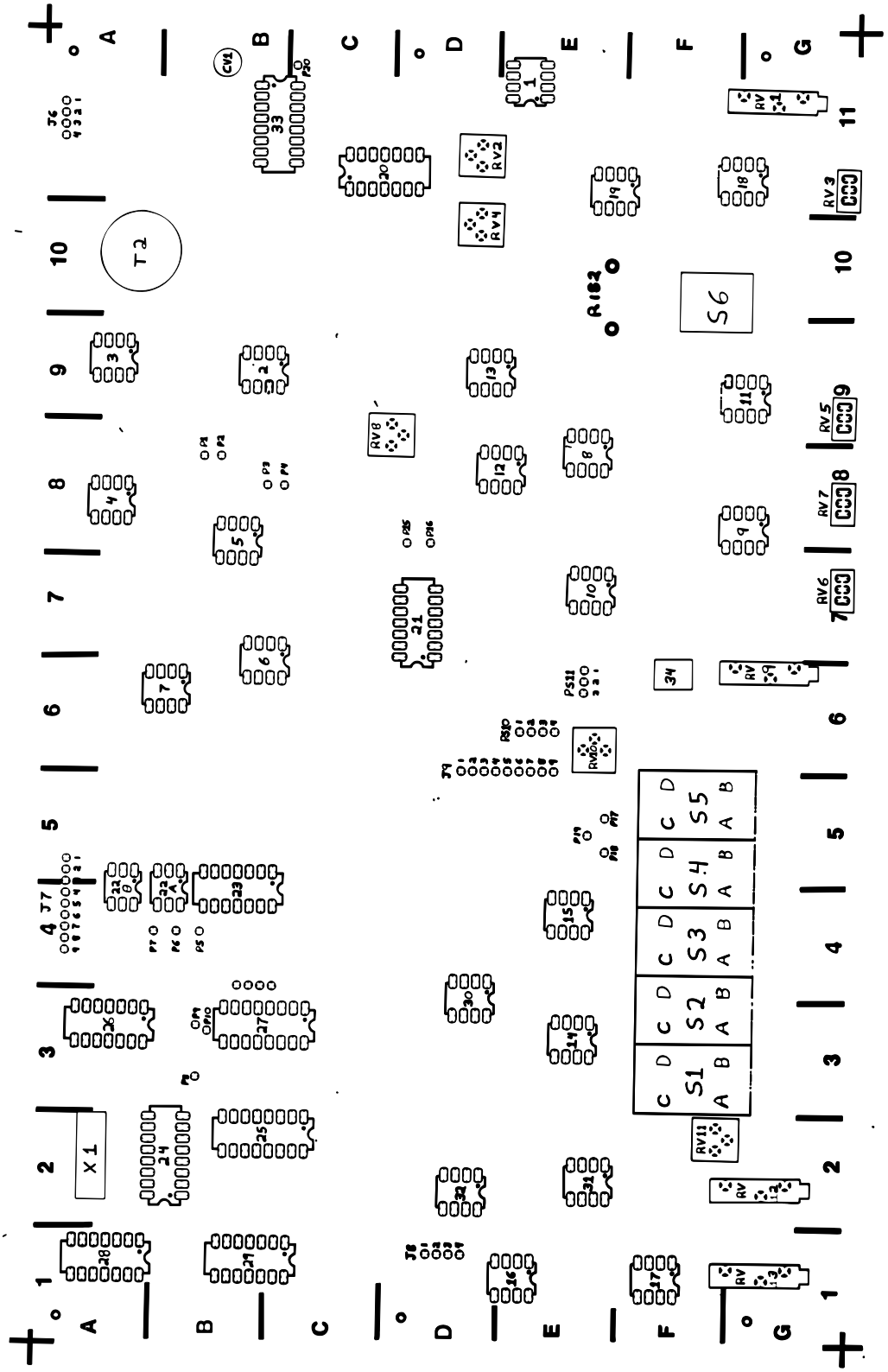
5. Adjust the meter calibration pot RV10 (location E6) to lower the reading on the AC voltmeter to 0.50 volts. The SIDEKICK deviation meter will now be calibrated to read correctly at 67 kHz.

6.5 Mute Delay Time Setting

Mute delay time (seconds)	R182 (kOhms)
0.3	0.0
0.5	0.47
0.75	1.1
1.0	1.8
1.5	3.6
2.0	5.6
3.0	12
4.0	24
5.0	56
6.0	open

Chapter 7: Parts Layout




S1
S2
S3
S4
S5
S6
X1
T2
A182
RV1
RV2
RV3
RV4
RV5
RV6
RV7
RV8
RV9
RV11

CHAPTER 8: SCHEMATIC: SEE FOLD--OUT PRINT, INSIDE BACK COVER

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Chapter 9: Parts List

9.1 Explanation of "Type" Abbreviations:

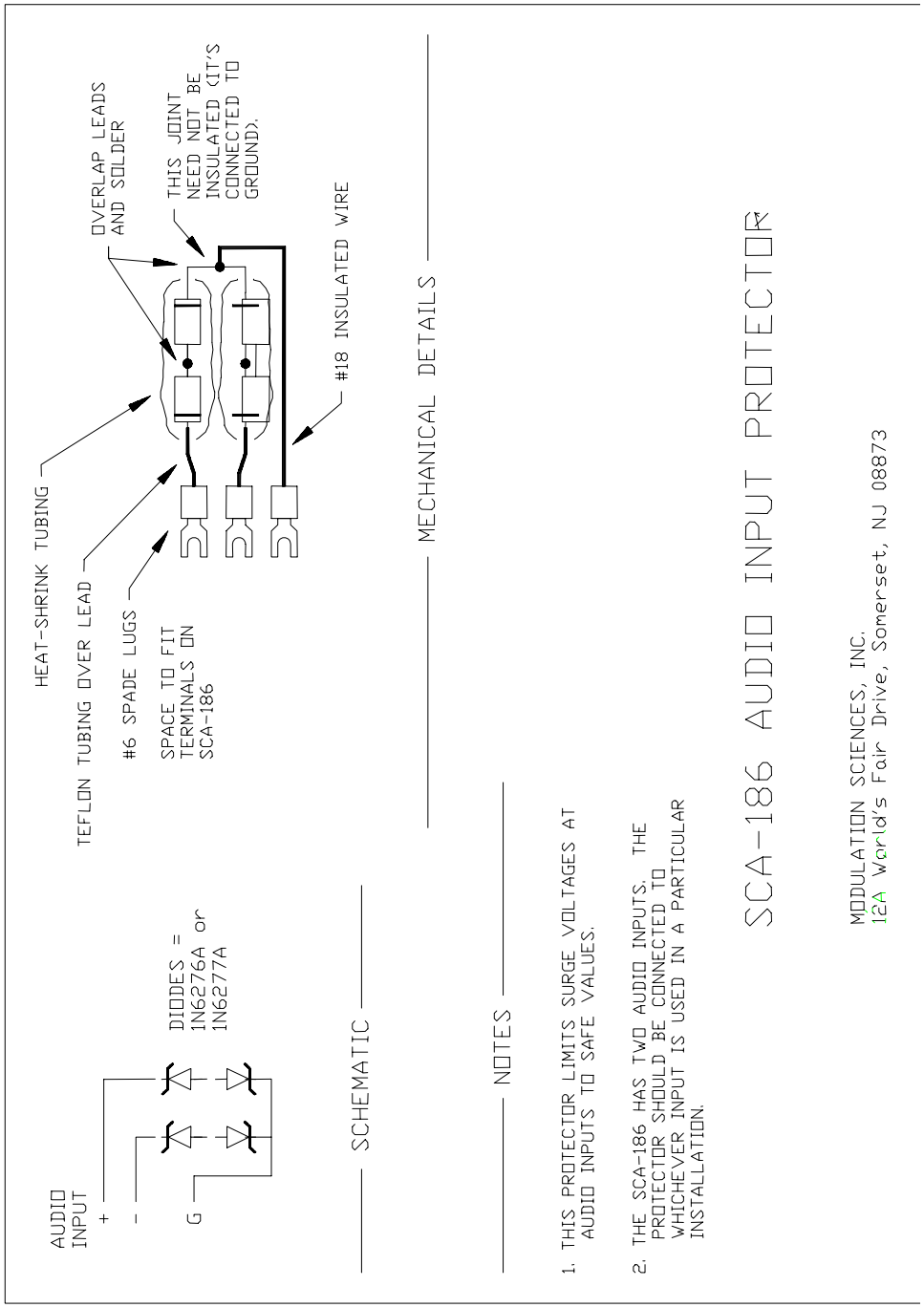
AE:	Aluminum Electrolytic Capacitor
BH:	Binding Head
BL:	Black
BUSH:	Bushing
CC:	Carbon Composition Resistor
CF:	Carbon Film Resistor
CM:	Cable Mount
DT:	Dip Tantalum Capacitor
FH:	Flat Head
LH:	Left Hand
LW:	Lock Washer
MC:	Monolithic Ceramic Capacitor
MF:	Metal Film Resistor
MINI-BAY:	Mini-Bayonet Base Lamp
MT:	Mount
MY:	Mylar Capacitor
OX:	Oxide Coated
PHIL:	Phillips Head
RH:	Round Head
SF:	Stacked Film Capacitor
SM:	Silver Mica Capacitor
SPAC:	Spacer
SS:	Solder Socket
WW:	Wire-Wrap Pin

9.2 Explanation Of "Manufacturer" Abbreviations:

ALLENBRADL	Allen-Bradley Co.
AMPHENOL	Amphenol
ANALOGDEVI	Analog Devices
ANALOGSYST	Analog Systems, Inc.
ARCO	Arco Electronics, Inc.
BELDEN	Belden Corporation
BUSSMAN	Bussman
CENTRALAB	Centralab, Inc.
CLAIREX	Clairex
CURTISINST	Curtis Instruments, Inc.

DENNISON	Dennison Manufacturing Co.
EXAR	EXAR
FAIRRITEPR	Fair-Rite Products Corp.
HEWLETTPAC	Hewlett-Packard
HEYMANMANU	Heyman Manufacturing Co.
HHSMITH	Herman H Smith Inc, N. American Phillips
IDI	Industrial Devices, Inc.
ITTSCHADOW	ITT Schadow, Inc.
KEYSTONE	Keystone Electronics Corp.
LEECRAFT	Leecraft Manufacturing Co., Inc.
MAGNETCOIL	Magnetic Coils, Inc.
MOTOROLA	Motorola,Inc.
MURATAERIE	Murata Erie North America, Inc.
NATIONALSE	National Semiconductor Corp.
OKMACHINE	OK Machine and Tool Corp.
PANDUIT	Panduit
RCA	RCA Solid State
ROBINSONNU	Robinson Nugent, Inc.
SAMTEC	Samtec
SIEMENS	Siemens Corp.
SIGNETICS	Signetics Corp.
SOLIDSTATE	Solid State Scientific, Inc.
SPECTROL	Spectrol Electronics Corp.
SPRAGUELEC	Sprague Electric Company
TEXASINSTR	Texas Instruments
TRIMTRONIC	Trim-Tronics, Inc.
TUSONIX	Tusonix, Inc.
USCRYSTAL	United States Crystal Corp.

Audio input protection circuit:



9.3 Parts List – SCA-186

MSI PART NUMBER	QTY	DESCRIPTION	REFERENCE DESIGNATOR	MANUFACTURER	MANUFACTURER PART NUMBER
V01-SCAM					
A02-M104FS001	1	TRIMPOT, 20T 1K00 FS SIDE	RV9	BOURNS	3006P1-102
A02-M106UT001	1	TRIMPOT, 20T 100K UR TOP	RV2	SPECTROL	64Y-104
A02-M204FS001	2	2K 20-T TRIMPOT	RV1,RV12	BOURNS	3006P1-202
A02-M205FS001	1	20K 20-T TRIMPOT	RV13	BOURNS	3006P1-203
A02-S106FT001	2	100K 1T FLAT TRIMPOT	RV4,RV11	BOURNS	3386P1-104
A02-S205FT001	1	TRIMPOT, 01T 20K0 FS TOP	RV10	BOURNS	3386P1-203
A02-S205US001	1	20K UPRIGHT TRIMPOT	RV7	BOURNS	3386W1-203
A02-S504US001	2	5K UPRIGHT TRIMPOT	RV5-RV6	BOURNS	3386W1-502
A02-S505FT001	1	50K 1-T FLAT TRIMPOT	RV8	BOURNS	3386P1-503
A04-1002JMEG1	3	CAP 10PF MC 10%	C59,C63,C85 (BACKSIDE)	AVX	SR151A100K
A04-1004RSND3	6	1 NF 1% SM 8.50MM LS 100V	C9-C10,C36-C39	CORNEL	CD19FA102F03
A04-1004SCDG1	1	1 NF 10% DISC	C48	CENTRALAB	CE102
A04-1005HMBG1	3	.01 UF 50 V 10% MC	C50,C82,C86(BACKSIDE)	MURATA ERIE	RPE110X7R103K50V
A04-1006HMCH1	14	.1 UF 50 V 20% MC	C45,C58,C70-C81	MALLORY	C20C104M5UICA
A04-1006JPNF1	5	.1 UF 5% 100V PY	C6-C8,C35,C47	WIMA	MKS4RM7 0.1/100/5 (7.5MM)
A04-1007GTNH1	4	1 UF 35 V DT	C23,C28,C54,C65	SPRAGUE	199D105X0035BB1
A04-1007HPNF1	1	1 UF 5% 63V PY LS 10MM	C44	WIMA MKS4RM10	1UF/5%/63V/PY/LS 10MM.
A04-1007HPNF1	2	1 UF 5% 63V PY LS 10MM	C1-C2 These parts are tested	Wima# MKS4RM10	1uf/5%/63v
A04-1008FTNH1	1	10 UF 25 V DT	C67	SPRAGUE	199D106X0025CB1
A04-1009FANI1	2	100 UF 25 V AE	C68,C69	ECE-B1EU01Y PAN/UCC	STANDARD RADIO
A04-1203UCBG1	1	120 PF DISC	C13	SPRAGUE	10TST12
A04-1503UCBG1	3	150 PF DISC	C12,C26,C60	SPRAGUE	10TST15
A04-1506GTNH1	1	.15 UF 35 V DT	C46	SPRAGUE	199D154X0035AB1
A04-1506JPNF1	1	.15 UF 5% 100V PY	C51	WIMA	MKS4RM10 .15/5/100 (10MM)
A04-1804JPNG1	1	1.8 NF 5% 100V PY	C56	WIMA	FKS3RM7 1800/100/5(7.5MM)
A04-2205JRNG1	2	0.022 UF 100 V 10% P	C17,C18	WIMA	
A04-2704MCFG1	1	2.7 NF, 100V,DISC,Y5P,10%	C49	MALLORY	SM272K
A04-3302JMAG1	1	33 PF 100 V 10% MC	C20	AVX	SR151A330KAA
A04-3303RSNE1	1	330 PF 2% SM 300V	C66	VARIOUS	DM15FD331G03

A04-3307FTNH1	4	3.3 UF 25 V DT	C21-C22,C27,C33	SPRAGUE	199D335X0025BB1
A04-3902UCBG1	1	39 PF 1KV CER DISC	C61	SPRAGUE	10TSQ39
A04-3903RSND1	3	390 PF 1% SM	C3-C4-C53	VARIOUS	CM05FD391F03
A04-3903UCBG1	3	390 PF DISC 5%	C32,C43,C52	ARCO	CCD391
A04-4708BTNH1	1	47 UF 6 V DT	C64	ITTCAP	TAP47M6.3
A04-5001UCBG1	3	5 PF DISC	C19,C24,C57	ARCO	CCD-050
A04-5604JMEG1	2	5.6 NF 100 V 10% MC	C11,C25	CENTRALAB	CW15A562K
A04-6802JMAG1	2	68 PF 100 V 10% MC	C40-C41	CENTRALAB	CN15A680K
A04-6804JRNF1	1	6.8 NF 5% 100 V PC	C55	WIMA	FKC2 6800/100/5 (7.5M)
A04-6807FTNH1	3	6.8 UF 25 V DT	C34,C42,C62	ITTCAP	68K35
A05-550118021	1	5.5-18 TRIM CAP	CV1	TUSONIX	538-011A-5.5-18
A06-FCORE0001	2	POT CORE (2 / UNIT)	T2	PHILIPS	2213P-L00-3B7
A10-032768001	1	3.2768 MHZ XTL PARAL CAP	X1	JANCRYSTAL	MP-HC33
BT1-000000001	5	1N5711 H.P. Schotty Diode test forward V. Drop, FXT. DF1	D15,D40-D43 (PARTS INSTALLED BY MSI!!!)		
B01-4148	44	GLASS DIODE	D1-D5,D9-D14,D16-D33,D44-D58	VARIOUS	1N4150
B04-N3904	2	2N3904 NPN TRANSISTOR TO92	Q7,Q10	VARIOUS	2N3904
B04-P3906	1	LOW POWER PNP TRANSISTOR	Q8	VARIOUS	2N3906
B04-P5087	1	LOW POWER TRANSISTOR	Q9	VARIOUS	2N5087
B05-N15202001	1	MED POWER TRANSISTOR	Q1	MOTOROLA	MPSU05
B05-P15202001	1	MED POWER TRANSISTOR	Q2	MOTOROLA	MPSU55
C01-1B0000003	2	NE5534P TI OP AMP, PLASTIC	U13,U15	TEXASINSTR	NE5534P
C01-1B0000004	1	MA332CP ANALOGSYST OP AMP	U14	ANALOGSYST	MA332CP
C01-2F0000002	3	LF412CN Dual OP AMP	U1-U2,U5	NATIONALSE	LF412CN
C01-2F0000007	13	TL082CP RAYTHEON DUAL OP AMP	U3-U4,U6-U12,U17,U30-U32	RAYTHEON	TL082CP
C03-100000002	1	INTERSIL WAVEFORM GENERATOR, CERMIC	U21	INTERSIL	ICL8038CCJD
C05-100000001	1	CA3080E RCA TRANSCOND AMP	U16	RCA	CA3080E
C07-200000002	1	DUAL VCA Obsolete	U20,	Curtis	CEM3335
C99-100000001	1	AD524AD ANALOG DEVICES BALANCED INPUT AMP	U33	ANALOGDEVI	AD524AD
D01-4006X0001	1	18 BIT SHIFT REG	U28	SGSATES	HCF4006BE
D01-401030001	1	PGMABLE DIVIDER	U25	RCA	CD40103BE
D01-401300001	1	DUAL D FLIP-FLOP	U26	MOTOROLA	MC14013
D01-4020X0001	1	14-BIT BINARY COUNT	U27	RCA	CD4020BE
D01-4060X0001	1	XTAL OSC/FREQ DIV	U24	SOLIDSTATE	SCL4060BE
D01-4070X0001	1	QUAD EXCL OR GATE	U29	NATIONALSE	CD4070BCN
ECO-CUT	2		SEE SAMPLE		
ECO-HOLE	1		DRILL 0.116" HOLE IN BACK OF, R192 ON TRACE		

ECO-JUMPER	1		AROUND NYLON HEX SPACER		
ECO-JUMPER	1		Q5C TO Q5E		
ECO-JUMPER	1		U34P2-U34P4 "Facing C55		
H05-008000001	20	8 PIN EDGE GRIP SS	US1-US17,US30-US32	TEXASINSTR	C930802
H05-014000002	5	14 PIN FACE GRIP SS	US20,US21,US26,US28-US29	AMP	2-641261-20
H05-016000002	3	16 PIN FACE GRIP SS	US24,US27,US33	AMP	2-641262-20
H06-016000001	1	16 PIN WW SOCKET	US25	ASSMAN	AR16-HZW
H08-001PMS001	1	TEST POINTS	P20	OXLEY	040/30P/KP2/L
H08-001PMW001	16	SINGLE WW PIN	P1-P4,P8-P19	SAMTEC	TSW-101-09-GS
H08-002CFW001	1	2 PIN FEM END CONN W/GOLD	J1	PANDUIT	
H08-002PMW002	1	2 PIN WW STRIP	1 PC. connects U34P3- U34P4	WIMA CAP REF# C55	
H08-003PMW001	1	3 PIN WW STRIP	PS11	SAMTEC	TSW-103-09-GS
H08-004PMS002	3	MASCON HEAD,4-PIN W/GOLD	J6,J8,J10	PANDUIT	MLSS100-4-DA or CA ending
H08-005CFW001	1	5 PIN END CONNECTOR,GOLD PLAT	J2		
H08-009PMS002	2	Straight Mascon Header	PS7,PS9	PANDUIT	MLSS100-9-DA
I02-020100201	1	ALT ACT 2P2T PC SWCH	S6	ITTSCHADOW	F2UEE
I02-050400201	1	5 STA INTERLOCK SWITCH	Stototo1to5	ITTSCHADOW	F17.5054UGRN
J03-P240X0001	4	Black 24 AWG stranded hook-up wire, UL1007	S6P3 TO J1P1		
J03-P240X0001	9	Black 24 AWG stranded hook-up wire, UL1007	R12,TO J2P,1		
J03-P241X0001	6	BROWN 24 AWG STRND WIRE	R77(TOP) TO J2P2		
J03-P242X0001	9	RED 24 AWG STRANDED HOOK-UPWIRE	R12PAD TO J2P3		
J03-P243X0001	6	ORANGE 24 AWG STRANDED HOOK-UP WIRE	R77(BOTTOM) J2P5		
J03-P249X0001	4	WHITE 24 AWG STRANDED HOOK-UP WIRE	S6P2 - J1P2		
K01-A02COV001	4	20-T TRIMPOT COVER	RVC1,RVC9,RVC12-RVC13	BOURNS	H-83-P
K01-I02IND001	1	BLK/YEL LAMPLESS INDICATOR (FA201)	SC6	ITTSCHADOW	FA201 BLACK/YELLOW
K01-I02IND002	3	BLK/GREEN LAMPLESS INDICATOR	SC3-SC5	ITTSCHADOW	FA101 BLACK/GREEN
K01-I02IND003	1	LAMPLESS INDICATOR BLK/ORANGE (FA101)	SC1	ITTSCHADOW	FA101 BLACK/ORANGE
K01-I02IND004	1	LAMPLESS INDICATOR BLK&YELLOW	SC2	ITTSCHADOW	FA101 BLACK/YELLOW
K04-1450D	9	4/40 X 3/4` HEX SPAC		KEYSTONE	1450D
K04-1902E	1	4/40X1" HEX SPACER NYLON	MNTING HOLE BACK OF R92		
K04-2205	3	4/40X1" HEX SPACER ALUM	RV5,RV6,RV7		
U05-PCGM	1	ASSEMBLY LABOR, V01-PCGM		MSI	PCGM
V04-SCA186T2	1	Transformer, (Wire/Bobbin) 3-pc.part			
Z01-000	5	O OHM 1/4W 5% CF	BY SCAM LOGO		
Z01-103	2	100 OHM 1/4W 5% CF	R19,R60	VARIOUS	1/4 W 5 % CF
Z01-104	4	1K 1/4W 5% CF	R17,R22,R61-R62	VARIOUS	1/4 W 5 % CF
Z01-105	15	10K 1/4W 5% CF	R11,R54,R73-R74,R88-R89,R115,R121,R128,R148,R153,R175,	R177,R178,R184	VARIOUS 1/4 W 5 % CF

Z01-106	7	100K 1/4W 5% CF	R68,R122,R140,R142,R170-R171,R180	VARIOUS	1/4 W 5 % CF
Z01-107	1	1 M 1/4W 5% CF	R123	VARIOUS	1/4 W 5 % CF
Z01-108	3	10 M 1/4W 5% CF	R86,R113,R166	VARIOUS	1/4 W 5 % CF
Z01-125	2	12 K 1/4W 5% CF	R161,R163	VARIOUS	1/4 W 5 % CF
Z01-126	3	120 K 1/4W 5% CF	R24,R59,R157	VARIOUS	1/4 W 5 % CF
Z01-127	1	1.2 M 1/4W 5% CF	R185	VARIOUS	1/4 W 5 % CF
Z01-155	2	15K 1/4W 5% CF	R52,R69	VARIOUS	1/4 W 5 % CF
Z01-156	2	150K 1/4W 5% CF	R91,R173	VARIOUS	1/4 W 5 % CF
Z01-186	3	180K 1/4W 5% CF	R10,R18,R134	VARIOUS	1/4 W 5 % CF
Z01-203	1	200 OHM 1/4W 5% CF	R168	VARIOUS	1/4 W 5 % CF
Z01-204	1	2 K 1/4W, 5% CF	R129	VARIOUS	1/4 W 5 % CF
Z01-222	2	22 0HM 1/4W 5% CF	R5-R6	VARIOUS	1/4 W 5 % CF
Z01-224	2	2.2K 1/4W 5% CF	R79,R188(BACKSIDE)	VARIOUS	1/4 W 5 % CF
Z01-225	5	22K 1/4W 5% CF	R1,R80,R126,R133,R141	VARIOUS	1/4 W 5 % CF
Z01-226	3	220K 1/4W 5% CF	R82,R85,R125	VARIOUS	1/4 W 5 % CF
Z01-227	1	2.2 M 1/4W 5% CF	R71	VARIOUS	1/4 W 5 % CF
Z01-274	1	2.7 K 1/4W 5% CF	R112	VARIOUS	1/4 W 5 % CF
Z01-275	2	27 K 1/4W 5% CF	R9,R72	VARIOUS	1/4 W 5 % CF
Z01-333	3	330 OHM 1/4W 5% CF	R162,R174,R187(BACKSIDE)	VARIOUS	1/4 W 5 % CF
Z01-334	5	3.3K 1/4W 5% CF	R81,R116,R118,R183,R186	VARIOUS	1/4 W 5 % CF
Z01-335	3	33K 1/4W 5% CF	R16,R131,R176	VARIOUS	1/4 W 5 % CF
Z01-363	1	360 OHM 1/4W 5% CF	R20	VARIOUS	1/4 W 5 % CF
Z01-435	1	43 K 1/4W 5% CF	R154	VARIOUS	1/4 W 5 % CF
Z01-474	1	4.7K 1/4W 5% CF	R169	VARIOUS	1/4 W 5 % CF
Z01-475	4	47 K 1/4W 5% CF	R51,R56,R70,R83	VARIOUS	1/4 W 5 % CF
Z01-476	1	470 K 1/4W 5% CF	R55	VARIOUS	1/4 W 5 % CF
Z01-477	2	4.7 M 1/4W 5% CF	R87,R165	VARIOUS	1/4 W 5 % CF
Z01-512	2	51 OHM 1/4W 5% CF	R147,R152	VARIOUS	1/4 W 5 % CF
Z01-514	1	5.1 K 1/4W 5% CF	R130	VARIOUS	1/4 W 5 % CF
Z01-515	1	51 K 1/4W 5% CF	R23	VARIOUS	1/4 W 5 % CF
Z01-563	1	560 OHM 1/4W 5% CF	R172	VARIOUS	1/4 W 5 % CF
Z01-564	1	5.6K 1/4W 5% CF	R132	VARIOUS	1/4 W 5 % CF
Z01-565	4	56 K 1/4W 5% CF	R67,R90,R124,R155	VARIOUS	1/4 W 5 % CF
Z01-567	1	5.6 M 1/4W 5% CF	R57	VARIOUS	1/4 W 5 % CF
Z01-624	1	6.2 K 1/4W 5% CF	R53	VARIOUS	1/4 W 5 % CF
Z01-625	2	62 K 1/4W 5% CF	R46,R58	VARIOUS	1/4 W 5 % CF
Z01-683	1	680 OHM 1/4W 5% CF	R111	VARIOUS	1/4 W 5 % CF
Z01-684	3	6.8 K 1/4W 5% CF	R4,R21,R179	VARIOUS	1/4 W 5 % CF

Z01-685	1	68 K 1/4W 5% CF	R158	VARIOUS	1/4 W 5 % CF
Z01-823	1	820 OHM 1/4W 5% CF	R108 "Should be facing	VARIOUS	1/4 W 5 % CF
Z01-824	1	8.2K 1/4W 5% CF	R156	VARIOUS	1/4 W 5 % CF
Z01-825	2	82 K 1/4W 5% CF	R78,R127	VARIOUS	1/4 W 5 % CF
Z01-826	1	820K 1/4W 5% CF	R84	VARIOUS	1/4 W 5 % CF
Z01-XXX	2	RESISTOR 5% SELECT AT TEST	R137,R181	VARIOUS	1/4 W 5 % CF
Z02-1005	15	10.0 K 1/4W 1% MF	R2-R3,R15,R47-R50,R63-R66,R95,R101,R146,R160	VARIOUS	1/4 W 1 % MF
Z02-1006	4	100 K 1/4W 1% MF	R114,R117,R119-R120	VARIOUS	1/4 W 1 % MF
Z02-1007	2	1.00 M 1/4W 1% MF	R7-R8	VARIOUS	1/4 W 1 % MF
Z02-1215	1	12.1 K 1/4W 1% MF	R164	VARIOUS	1/4 W 1 % MF
Z02-1504	1	1.50 K 1/4W 1% MF	R143	VARIOUS	1/4 W 1 % MF
Z02-1625	1	16.2 K 1/4W 1% MF	R135	VARIOUS	1/4 W 1 % MF
Z02-1824	2	1.82 K 1/4W 1% MF	R40,R41		1/4W 1% MF
Z02-2104	1	2.10 K 1/4W 1% MF	R159	VARIOUS	1/4 W 1 % MF
Z02-2105	2	21.0 K 1/4W 1% MF	R43-R44	VARIOUS	1/4 W 1 % MF
Z02-2265	2	22.6 K 1/4W 1% MF	R42,45		1/4W 1% MF
Z02-2675	2	26.7 K 1/4W 1% MF	R99,R151	VARIOUS	1/4 W 1 % MF
Z02-3015	3	30.1 K 1/4W 1% MF	R75-R76,R149	VARIOUS	1/4 W 1 % MF
Z02-3244	1	3.24 K 1/4W 1% MF	R139	VARIOUS	1/4 W 1 % MF
Z02-3404	1	3.40 K 1/4W 1% MF	R138	VARIOUS	1/4 W 1 % MF
Z02-3924	1	3.92 K 1/4W 1% MF	R96	VARIOUS	1/4 W 1 % MF
Z02-3925	1	39.2 K 1/4W 1% MF	R93	VARIOUS	1/4 W 1 % MF
Z02-4424	1	4.42 K 1/4W 1% MF	R167	VARIOUS	1/4 W 1 % MF
Z02-4994	4	4.99 K 1/4W 1% MF	R94,R100,R144-R145	VARIOUS	1/4 W 1 % MF
Z02-5114	1	5.11K 1/4W 1% MF	R14	VARIOUS	1/4 W 1 % MF
Z02-5625	1	56.2 K 1/4W 1% MF	R13	VARIOUS	1/4 W 1 % MF
Z02-7154	1	7.15 K 1/4W 1% MF	R92	VARIOUS	1/4 W 1 % MF
Z02-7503	1	750 OHM 1/4W 1% MF	R97	VARIOUS	1/4 W 1 % MF
Z02-7684	2	7.68 K 1/4W 1% MF	R98,R150	VARIOUS	1/4 W 1 % MF
Z02-8664	1	8.66 K 1/4W 1% MF	R136	VARIOUS	1/4 W 1 % MF
Z03-2215	1	22.1 K 1/4W 1% MF RN55 50 PPM	R12	RCD	MF55C - SORTED

MSI PART NUMBER	QTY	DESCRIPTION	REFERENCE DESIGNATOR	MANUFACTURER	MANUFACTURER PART NUMBER
V01-SCAP					
A02-S105US001	2	10K UPRIGHT TRIMPOT	RV1,RV2	BOURNS	3386W-1-103
A04-1006JPNG1	9	.1 UF 100V MET/POLY 10%	C1-C6,C16,C18,C23	PAN	ECQ-E1104KF
A04-1008FANH1	3	10 UF 35V EL 20%	C21,C22,C24		
A04-3302RCAF1	1	33PF 100V CER NPO 5%	C20	PAN	ECC-F2A330JCE
A04-4705JPNF1	2	.047 UF 100V MET/POLY FILM	C7,C8	PAN	ECQ-E1473KF
A04-4708HANG1	5	47UF 50V 10%EL 2.5mmLS	C10,C11,C13,C14,C17	PAN	ECE-A1HU470
A05-150260021	1	15-60PF TRIM CAP	C19	MURATA	DV11PS60Q
A10-040000001	1	4.000 MHZ CRYSTAL	XTAL1	ACCORD	4.000 MHZ CRYSTAL
B01-1N914	8	GLASS DIODE	D1-D8	VAR	1N914
B04-N3904	2	2N3904 NPN TRANSISTOR TO92	Q2,Q3	VAR	2N3904
B05-J310	1	N CHANNEL FET	Q1	MOT	J310
C01-2F0000012	4	DUAL OP AMP PLASTIC	U1-U4	TI	TL074CN
C01-MX165CP	1	TONE DECODER, PLASTIC	U13	MX-COM	MX165CP
C02-1P501L001	1	+5 VOLT 5% LOW PWR R	U12	NSC	LM78L05ACZ
C06-100000002	6	4N37 GEN. ELEC. OPTO ISOLATOR	U6-U11	VAR	4N37
D01-CGS3322M	1	OCS/DRIVER, SURF. MOUNT	U5	NSC	CGS3322M
H08-003PMS001	1	MASCON 3-PIN LATCHEADW/GOLD	H2 POWER	PANDUIT	MLSS100-3-CB OR DB
H08-004PMS002	1	MASCON HEAD,4-PIN W/GOLD	H3 IND	PANDUIT	MLSS100-4-DA OR DB
H08-005PMS001	1	MASCON 5-PIN HEAD. W/ GOLD	H1 AUDIO	PANDUIT	MLSS100-5-DA OR DB
H08-012PMS001	1	MASCON 0.1" 12 PIN HEADER	H4 CTL	PANDUIT	MLSS100-12-CB OR DB
J01-260000001	4	BUS WIRE, TINNED, 26AWG	C9P1-C9P2, U10P4-C20 (bot), R28(bot)-U3P3,R21(top)-R28(bot)		
U05-SCAP	1	ASSEMBLY LABOR, V01-SCAP		MSI	V01-SCAP
Z02-1005	15	10.0 K 1/4W 1% MF	R5-7,R9-11,R14-15,R18-20,R25,R28,R32,R47		
Z02-1006	4	100 K 1/4W 1% MF	R1-2,R37,R59		
Z02-1075	1	10.7 K 1/4W 1% MF	R24		
Z02-1504	1	1.50 K 1/4W 1% MF	R57		
Z02-1505	4	15.0 K 1/4W 1% MF	R48,R49,R55,R56		
Z02-1585	1	15.8K 1/4W 1% MF	R53		
Z02-1785	1	17.8K 1/4W 1% MF	R29		
Z02-1825	1	18.2 K 1/4W 1% MF	R35		

Z02-1875	2	18.7 K 1/4W 1% MF	R4,R8
Z02-2004	1	2.0 K 1/4W, 1% MF	R60
Z02-2005	1	20.0 K 1/4W 1% MF	R34
Z02-2105	2	21.0 K 1/4W 1% MF	R22,R23
Z02-2215	5	22.1K 1/4W 1% MF	R26-27,R31,R33,R38
Z02-2264	2	2.26 K 1/4W 1% MF	R50,R51
Z02-2435	1	24.3K 1/4W 1% MF	R16
Z02-2744	6	2.74 K 1/4W 1% MF	R39,R42-R46
Z02-3013	1	301 OHM 1/4W 1% MF	R58
Z02-3325	1	33.2 K 1/4W 1% MF	R21
Z02-3484	1	3.48 K, 1/4W, 1%, MF	R3
Z02-3924	1	3.92 K 1/4W 1% MF	R12
Z02-4755	2	47.5 K 1/4W 1% MF	R41,R52
Z02-4874	1	4.87 K 1/4W 1% MF	R36
Z02-6194	1	6.19 K, 1/4W,1% MF	R54
Z02-8454	2	8.45K 1/4W 1% MF	R13,R17

MSI PART NUMBER	QTY	DESCRIPTION	REFERENCE DESIGNATOR	MANUFACTURER	MANUFACTURER PART NUMBER
V02-SCAH					
A04-1203UCBG1	4	120 PF DISC	C502-C505	SPRAGUE	10TST12
A04-1504XHNI1	4	1.5 NF FEED-THRU	C501,C506-C508	TUSONIX	357-001-X5U0-152M
A04-3301UCBG1	1	3.3 PF DISC	C509	CENTRALAB	DD3R3
A06-FBEAD0001	4	FERRITE BEAD	L501-L504	FAIRRITEPR	2743002111
A08-112202801	1	PWR XFRMR, DUAL 28VCT 0.42A	T1	MAGNETCOIL	######
A09-S3AG01251	1	FUSE, SLOW BLOW, 1/8 AMP	F1	LITTLEFUSE	313.125
B01-000000001	1	1N5711 H.P. SCHOTTKY DIODE	D501	HEWLETTPAC	1N5711
B02-6276A	4	16V TRANS SUPPRESSOR	D502-D505	MOTOROLA	1N6276A
E01-I40000001	1	YELLOW LED, IDI# 5100H7	D38, READY LED	IDI	5100H7
E01-I50000001	1	GREEN LED IDI# 5100H5	D39, CARRIER LED	IDI	5100H5
E02-282080001	1	28V MINI-BAY LAMP	B1	MICROLAMP	757
G04-GBU	2	PC BOARD	PCB5-PCB6	QUALITYCIR	GBU
H02-002F00002	5	CONNECTOR, BNC FEMALE, UG1094U	J1-J5	AMPHENOL	31-221
H04-PN0000001	1	FUSE HOLDER	FH1	BUSSMAN	HKP
H08-002CFW001	1	2 PIN FEM END CONN W/GOLD	J12 (CTCSS CARRIER LED, D39 WHITE= P1)		
H08-004CFW001	2	4 PIN CM END CONNECT W/GOLD	J6,J8	PANDUIT	CE100F24-4-DA
H08-009CFW001	2	9 PIN CM END CONNECT W/GOLD	J7,J9	PANDUIT	CE100F24-9-DA
H08-012CFW001	1	12 PIN FEM END CONN	J11 CTCSS CABLE		
H09-002GS0001	1	2 TERMINAL STRIP		HHSMITH	820
H09-012PR0001	1	12 POS 6/32 SCREW Terminal		BEAUPRODUC	71712
H10-025F00007	1	25P FEM D CONN FILTERED	J10 (CTCSS CONTROL)		
H11-CRN160401	2	Crimp lug, screw size 6, 22-18 awg Keystone# 8200	GREEN-POWER CORD, GRAY-METER.	ZIERICKMAN	A3651W/.144"HOLE
H11-CSI180601	3	NO.6 SPADE LUG FOR 22-18		VACO	63206
H99-001000001	1	PANEL MT BNC GND LUG		AMPHENOL	31-759
J07-P18000001	1	6 FOOT LINE CORD, 1.8 METERS	CH1	BELDEN	17237B
K04-1450C	4	4/40 X 1/2` HEX SPACER	UPSA PWBA	KEYSTONE	1450C
K05-E02000001	1	MINI-BAY LAMP HOLDER	BH1	LEECRAFT	6-Jul
K06-D08461	4	ADHESIVE WIRE TIE MT		DENNISON	8461
K06-H3510NT90	14	5 1/2 inch long cable tie		HEYMANMANU	3510NT90
K06-PTM2S6M	3	WIRE TIE MOUNT		PANDUIT	TM2S6-M
K09-H10SCL001	1	`D` SUB SCREWLOCK-SET OF 2 PCS	FASTEN H10-025F00006		
K99-000000003	1	3/8` STEEL HOLE PLUG			

O05-000000001	1	STRAIN RELIEF, 5N-4 BLACK			HEYMANMANU	5N-4BLACK
O09-000000001	13	SMALL POP RIVET			AVDEL	1693-0410
V03-SCAR	1	PWB ASSY, REGULATOR, SCA (ALL)			MSI	
V03-SCAT	1	PWB ASSY, TERMINAL, SCA (ALL)			MSI	
V03-UPSA	1	PWB ASSY, POWER SUPPLY			MSI	
V04-SCA186M1	1	PEAK DEVIATION METER	M1		MODUTEC	01-130-039
Z05-512	1	51 OHM 2W 5% CC HB TYPE	R501		ALLENBRADL	HB TYPE 2W 5% CC
Z10-103	1	100 OHM 10% 1WATT GB Type	R502		ALLENBRADL	GB TYPE 1 W 10 % CC

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V03-SCAR					
A04-1006HMCH1	2	.1 UF 50 V 20% MC	C301-C302	CENTRALAB	CZ20C104M
A04-1007GTNH1	2	1 UF 35 V DT	C305-C306	SPRAGUE	199D105X0035BB1
A04-100AGANH1	1	1000 UF 35V AE 20%	C307	PANA	ECE-B1VGE102
A04-6807FTNH1	2	6.8 UF 25 V DT	C303-C304	SPRAGUE	199D685X0025CB1
B01-4003	1	RECTIFIER DIODE	D301	VARIOUS	1N4003
C02-1NVARM001	1	LM337T VOLTAGE REG. ADJ.-1.5 AMP TO-220	U302	TEXASINSTR	LM337KC
C02-1PVARM002	1	LM317T VOLTAGE REG. ADJ +1.5 AMP TO-220	U301	TEXASINSTR	LM317KC
G04-SCAR2	1	PC BOARD W/SOLDER MASK & SILKS	PCB3	QUALITYCIR	SCAR-2
K02-000000003	2	ELECT. ISOLATING THE		BERGQUIST	K4-62
K02-3051	2	NO 2 SHOULDER BUSH		KEYSTONE	3051
K06-4INCH	1	4 INCH CABLE TIES			
K08-SCARMB	1	MOUNTING BRACKET	MB301	MSI	SCAR-MB
O03-2/56M3801	2	2/56 X 3/8` ROUND HD, PHILIPS		VARIOUS	NONE
O03-2/56N0001	2	2/56 HEX NUT, STEEL ZINC		VARIOUS	NONE
O03-4/40M3801	1	4-40 X 3/8 PHILIP PAN HEAD		VARIOUS	NONE
O03-4/40N0001	1	4-40 HEX NUT, STEEL ZINC		VARIOUS	NONE
O03-NO.4I0001	1	NO. 4 INT LOCK WASH,STEEL ZINC		VARIOUS	NONE
Z01-105	1	10K 1/4W 5% CF	R306	VARIOUS	1/4W5%CF
Z01-825	1	82 K 1/4W 5% CF	R305	VARIOUS	1/4W5%CF
Z02-1024	2	1.02 K 1/4W 1% MF	R301-R302	VARIOUS	1/4 W 1 % MF
Z02-1213	2	121 OHM 1/4W 1% MF	R303-R304	VARIOUS	1/4 W 1 % MF

MSI PART NUMBER	QTY	DESCRIPTION	REFERENCE DESIGNATOR	MANUFACTURER	MANUFACTURER PART NUMBER
V03-SCAT					
A04-1203UCBG1	2	120 PF DISC	C401-C402	SPRAGUE	10TST12
A04-2703UCBG1	6	270 PF CER DISC, 2KVDC 10% NO DD-271 !! Too Big!!	C403-C406	CENTRALAB	DD-271
A06-FBEAD0001	8	FERRITE BEAD	L401-L402,L404-L407	FAIRRITEPR	2743002111
A06-FBEAD0002	2	FERRITE BEAD	L403	FAIRRITEPR	28730024020
G04-SCAT	1	PC BOARD 3 larger holes are #19 drill	PCB4	QUALITYCIR	SCAT
H08-004CFW001	1	4 PIN CM END CONNECT W/GOLD			
K06-H3510NT90	2	5 1/2 inch long cable tie		HEYMANMANU	3510NT90
Z02-3014	2	3.01 K 1/4W 1% MF	R402-R403	VARIOUS	1/4 W 1 % MF
Z02-6653	3	665 OHM 1/4W 1% MF	R401,R404-R405	VARIOUS	1/4 W 1 % MF